## REMARKS

This is a reply to the Office Action dated July 11, 2007, in the above-referenced patent application. Applicant thanks the Examiner for carefully considering the application.

### Status of Claims

Before this reply, Claims 1-23 were pending, claims 24-26 have been withdrawn from consideration. By way of this reply, new claims 27-30 have been added. Thus, claims 1-23 and 27-30 are currently pending. Claims 1 and 12 are independent.

### Claim Amendments

By way of this reply, withdrawn claims 24-26 have been canceled without prejudice or disclaimer. Claims 1 and 7 have been amended following the Examiner's suggestions. New claims 27-30 have been added. No new matter has been added by way of these amendments and none of these amendments is made in view of prior art.

### Claim Objections

Claim 1 is objected to for minor informalities. By way of this reply, claim 1 has been corrected following the Examiner's suggestions. Accordingly, withdrawal of the objection is respectfully requested.

### Rejections under 35 U.S.C. 112

Claims 7-10 are rejected as it is unclear of whether claim 7 is a method or apparatus claim. By way of this reply, claim 7 has been responsively amended to recite the method. Accordingly, withdrawal of the rejection of claims 7-10 is respectfully requested.

**Rejections under 35 U.S.C. 102(e)**

Claims 1-23 are rejected as being anticipated by U.S. Patent No. 6,775,324 ("Mohan"). For at least the following reasons, this rejection is respectfully traversed.

The claimed invention is directed to apparatus and method for ultra narrow band wireless communications. Independent claim 1 requires, in part, filtering the digital data with a bandpass filter having essentially no group delay. Independent claim 12 requires an ultra narrow band filter with substantially zero group or envelope delay.

When making the rejection, the instant Office Action has failed to read in at least the above-mentioned limitations, and further has failed to read in most of the limitations presented in the dependent claims, rendering the rejection improper. Accordingly, withdrawal of the rejection is respectfully requested.

To help advance the examination of this case, Applicant further respectfully submits that Mohan teaches one of the conventional method that has a substantially group delay or envelope delay. As further discussed below with respect to Fig. C of this reply, **the illustrations in Mohan clearly show the effects of group delay in that there is no instantaneous phase change, the phase change being integrated over one or more bit periods causing Bessel products as well as Fourier products. This is characteristic of all conventional CPFSK methods that have substantial group delay or envelope delay.**

More specifically, Mohan has altered the non-return to zero (NRZ) format to generate a variable phase shift keying (VPSK) code as taught by Walker, and has added spread spectrum technology to that code. Mohan uses conventional modulation techniques, but alters the content of the signal within the data symbol period. Mohan further uses the Armstrong quadrature technique to obtain phase modulation (PM). By contrast, some embodiments of the claimed invention involves no phase modulation of the carrier, but use an abrupt phase switched carrier (see, e.g., Figure 2, and paragraphs [0033], [0037], and [0043] of the published application – Pub. No. 20040121731).

VPSK has a spectrum similar to that of coded bi-phase shift key modulation (BPSK) in that it has no carrier. All of the useful energy is in the sidebands. By contrast, some embodiments of the claimed invention remove the sidebands (e.g., claim 28; see also Figs. 5, 10 and 14 of the present application.)

Mohan clearly specifies the use of conventional BPSK modulation (see, e.g., col. 3, lines 3-4), which as well known in the art employs 180 degree phase shift with predominant sidebands and is generally **used to remove the carrier and shift all energy to the sidebands** as seen in Fig. A below. By contrast, some embodiments of the invention, for example, that of newly added claim 27 requires an approximately 90 degree modulation rather than the 180 degree modulation to preserve the carrier (see, also, paragraphs [0033] and [0039] of the published application).

The Mohan method creates a signal having a frequency spread from ( $f_c$ - $R_b$ ) to ( $f_c$ + $R_b$ ) as seen in Fig. B below. This is the conventional Nyquist bandwidth. It is clearly not a narrow band signal as generated by some embodiments of the claimed invention, which transmits only a single frequency having no bandspread (see, e.g., Figs. 10 and 14 of the present application).

Although Mohan refers to the 'carrier', the total signal energy package therein consists almost entirely of sidebands. Some of the figures show a signal that can contain some carrier energy depending on the symbol pattern. However, these waveforms contain extensive Bessel products, which some embodiments of the claimed invention seek to remove (e.g., claim 8 of the present application; see, also, Fig. 10, and paragraph [0043] of the published application).

The fact that Mohan only teaches conventional modulation methods is further evidenced by the claims 1 – 4 of Mohan, which describe almost all modulation methods in present use that are a description of conventional BPSK modulation which dates to the 1920's.

Abrupt phase change is also well established in the art with many modulation sources. It is used ahead of a CPFSK type filter (see, e.g.,

paragraph [0042] of the published application, and Fig. C below) in all cases <u>except in the Ultra Narrow Band</u> methods patented by Walker and others.

Regarding claims 5 and 16, Applicant further respectfully submits that contrary to the assertions in the instant Office Action, Mohan does not teach abruptly phase shift keying the digital data in the NRZ format. Rather, Mohan clearly states (see, e.g., col. 4, lines 64-65) that "the NRZ data per se is not used to switch the biphase modulator," i.e., Mohan does *not* use NRZ per se to abrupt phase change the modulator. Abrupt phase change per se is an important requirement of some embodiments of the claimed invention (see, also, paragraphs [0037], [0043], and [0050] of the published application).

Mohan's claims regarding a receiving apparatus can only be applied to Mohan's composite signal, otherwise Mohan employs methods that are well known in prior art.

The validity of Mohan's methods rests totally on the combination of altered VPSK modulation (as taught by Walker) with spread spectrum technology. Mohan states, in col. 5, lines 61-63, "a bandpass filter is required to remove *out of band Fourier components* and provide only the sideband signal component." By contrast, some embodiments of the claimed invention remove all sidebands and pass only the carrier (see, e.g., Figs. 10 and 14 of the present application). Out of band components refer to those outside the bandwidth shown in Fig. B herewith. Some embodiments of the claimed invention seek to remove all Fourier and Bessel components, as described in, for example, paragraph [0043] of the published application.

Mohan further states, in col. 5, line 66 through col. 6, line 1, "the filtered single sideband signal from this filter is the J1 Bessel product of the encoded signal". By contrast, the signal of some embodiments of the claimed invention ideally contains no Bessel sideband products, and all Fourier sideband products are removed as well. There is no $\Delta f$ to create Bessel sidebands (see, e.g., paragraphs [0033] and [0043] of the published application).

Mohan teaches a broadband (spread) spectrum. The spectrum of a spread spectrum signal traditionally has a bandwidth equal to the 'chip' rate. By

contrast, the transmitted signal of some embodiments of the claimed invention is a single carrier frequency, with little or no sideband component energy (see, e.g., Fig. 14 of the present application).

Regarding claim 4, Applicant further respectfully submits that when making the rejection, the instant Office Action has failed to read in the limitations "where abruptly phase shift keying the digital data inserts substantially all necessary phase modulation information into the carrier alone with an insubstantial amount of any necessary phase modulation information inserted into the Fourier sidebands," rendering the rejection improper.

To help advance the examination of the present application, Applicant respectfully submits that Mohan teaches conventional modulation methods that have useful information in the sidebands, contrary to the requirements of claim 4 (see, also, paragraph [0033] of the published application).

Sidebands result in associated Fourier products and from $\Delta f$, which results from the basic physical equation $\Delta f = \Delta\Phi/2\pi\Delta t$, resulting in Bessel products. $\Delta f$ can be calculated from the basic relationship $\omega t = \Phi = 2\pi ft$. This can be rewritten in derivative form as $\Delta f = \Delta\Phi/2\pi\Delta t$ (see, e.g., paragraphs [0045] and [0046] of the published application).

It is well known to those skilled in the art that the group delay (rise time) for conventional filters is traditionally calculated from the following basic relationship (see, e.g., paragraph [0051] of the published application):

$$T_g = [\Delta\Phi / (2\pi\ \Delta f)].$$

In an embodiment of the invention, $\Delta\Phi$ is maintained at zero for the major portion of a data bit so that there is no $\Delta f$. $\Delta f$ occurs only during the phase transitions and can be removed in the filters without effect on the phase of the carrier. The sidebands that remain after FM removal are Fourier amplitude products that have no effect on phase. Thus, only the carrier needs to be transmitted when abrupt change phase modulation is used, as required by claim 28 (see, e.g., paragraph [0042] and Fig. 4 of the published application).

All conventional modultion methods, including those of Mohan, require the recovery of the Bessel or Fourier sidebands and must use filters that have a bandwdith wide enough to pass the sidebands. This is the basis of the Nyquist bandwidth criteria published in most texts and is well known in the art. See Fig. B below from “Wireless Communications”, Rappaport, Prentice Hall 1996.

In contrast to Mohan, some embodiments of the claimed invention have all the necessary phase information in the carrier, and the sidebands are removed (e.g., claim 28). To recover the signal, a special ultra narrow band filter having zero, or near zero group delay is required. This filter is dependent upon the unique characteristics of a crystal (e.g., claim 30; see also paragraphs [0050] and [0051] of the published application) where there is a phase inflection point and $\Delta\Phi = 0$.

The commonly used BPSK method also has abrupt phase switching as do many other modulation methods. The difference between some embodiments of the claimed invention and the commonly used methods includes the combination of the abrupt phase switching with the unique characteristics of a zero group delay filter (see, e.g., paragraphs [0033] and [0052] of the published application), which is a filter where $\Delta\Phi$ is near zero for most of the bit period. BPSK and other methods all use conventional filters where $\Delta\Phi$ varies with time (see, e.g., Fig. C below ), and there are FM Bessel as well as Fourier AM products present, so that these sideband products are necessary for the recovery of the modulated information.

In some embodiments of the claimed invention, the FM Bessel sidebands are eliminated (see, e.g., paragraph [0050] of the published application), and the Fourier sidebands can be removed in a narrow band filter (see, e.g., paragraph [0052] of the published application), since the necessary modulation information is retained in the carrier. This is not possible in conventional methods where the carrier is removed, as does Mohan.

As required by claim 27, the carrier is abrupt phase change modulated by a phase change amount of approximately 90 degrees instead of the 180 degrees used by BPSK. This results in both the carrier and the sidebands being present

instead having sidebands only. Since the abrupt phase change carrier contains the phase change, the sidebands can be removed (see, e.g., paragraphs [0040], [0043], and [0050] of the published application).

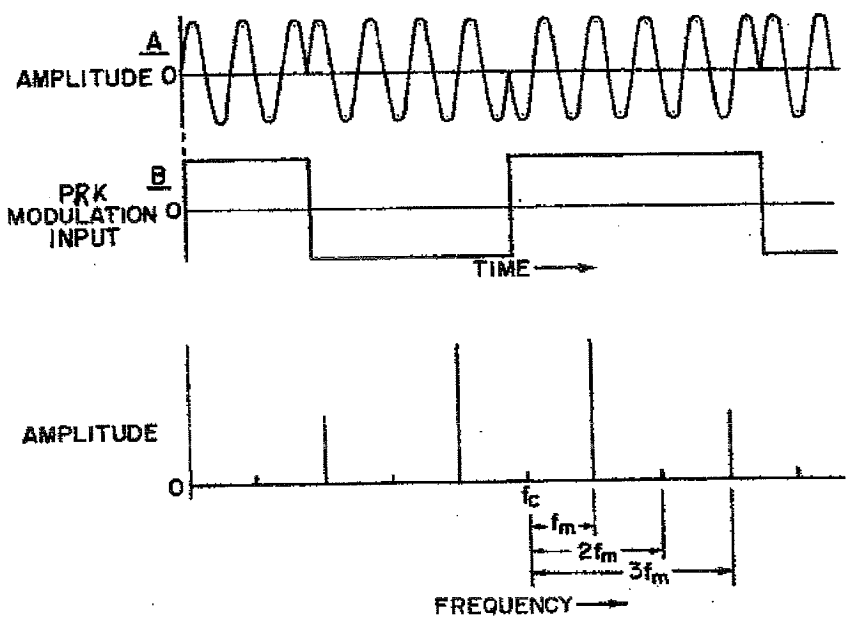


Fig. A, Textbook illustration of BPSK modulation and sidebands. The spectrum with a varying data pattern input such as that from an NRZ input signal is shown in Fig. B below.

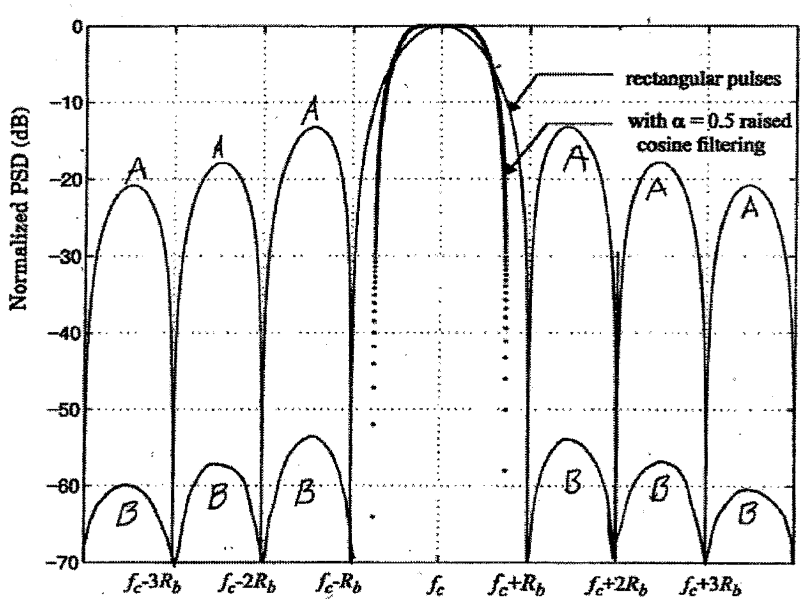


Fig. B The RF Spectrum for BPSK modulation (from Rappaport ). The Nyquist filter bandwidth is shown at the center. This raised cosine type filter has group delay as do all conventional filters which must pass sidebands.

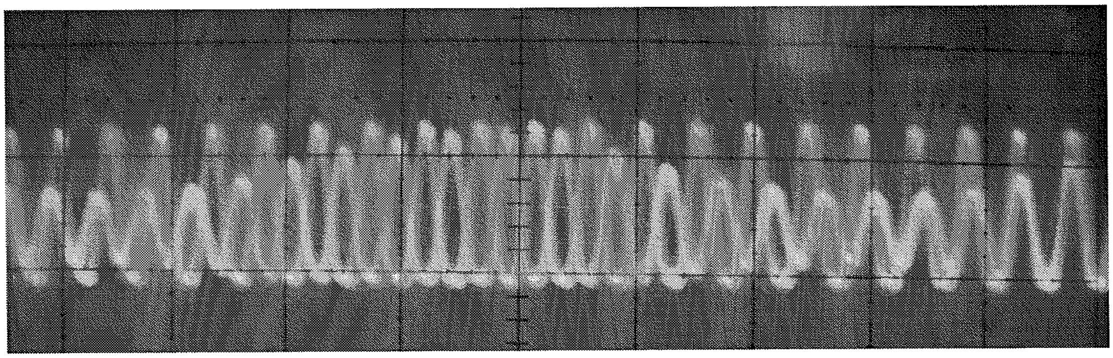

Fig. C. The slow phase shift (see, e.g., paragraph [0042] of the published application) that occurs with a filter having a large group delay when used with ordinary BPSK. The maximum data rate possible depends on this phase slew rate, which is related to filter group delay, or rise time. This is a continuous phase frequency shift keying system (CPFSK), which is well known in the art. A finite $\Delta\Phi/\Delta t$ has been deliberately introduced by the conventional filter. This in turn creates a $\Delta f$, and some of the sidebands which are normally observed. The illustrations in Mohan clearly show the effects of group delay in that there is no instantaneous phase change, the phase change being integrated over one or more bit periods causing Bessel products as well as Fourier products. This is characteristic of all CPFSK methods. The present invention is not a CPFSK method, but an abrupt phase change method. There is no slow phase shift as shown above, but an abrupt phase change due to the near zero group delay filter action at a single frequency (see, e.g., paragraphs [0042] and [0043] of the published application).

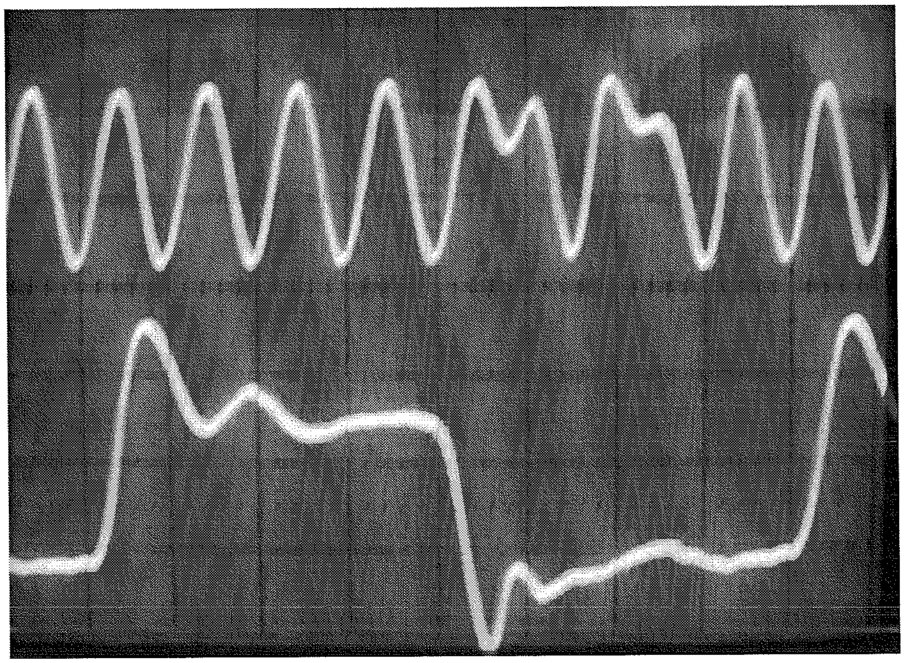

Fig. D. The response of **a zero group delay narrow bandpass filter (used with some embodiments of the claimed invention)** to abrupt phase changes when only one IF cycle has been reversed. Note that the edges (where the frequency Δf goes to +- infinity) show up as missing IF cycles as noted in Fig. A at the transition edges (see, also, paragraphs [0051] and [0052] of the published application).

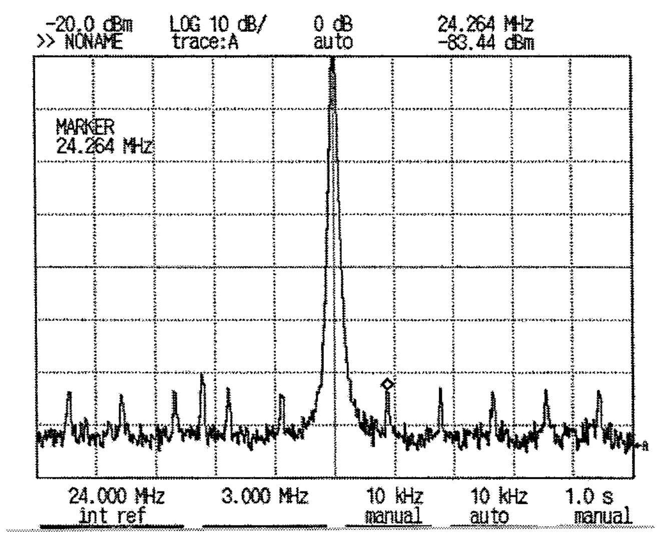


Fig. E. The spectrum resulting from some embodiments of the claimed invention after multiple stages of zero group delay ultra narrow bandpass filtering. The swept response of a single filter stage is given in Fig. 7 of the present application. Figure 6 is the

applicable schematic. The filter has near zero group delay only at a single frequency. See also Figs. 14 and 15 of the present application.

In summary, in conventional methods, all modulation information is said to be in the sidebands and the carrier can be removed. Also traditionally, only one sideband is necessary to carry information. By contrast, some embodiments of the claimed method do not function in this manner. The phase switched carrier alone carries the necessary information (see, e.g., paragraphs [0033] and [0043] of the published application.

In view of the above, the rejection as set forth in the instant Office Action is improper and should be withdrawn. Further, Mohan fails to show or fairly suggest all of the claimed limitations. Accordingly, withdrawal of the rejection of claims 1-23 is respectfully requested.

**New Claims 27-30**

New claims 27-30 depend from claim 1 and thus should be also allowable for at least the same reasons discussed above with respect to independent claim 1. Accordingly, entry and favorable consideration are respectfully requested.

## CONCLUSION

In view of the foregoing amendments and remarks, Applicants believe that the claims are in condition for allowance. Reconsideration, re-examination, and allowance of all claims are respectfully requested. The Examiner is encouraged to telephone the undersigned or his associates if any issues arise.

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Respectfully submitted,

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